Educational Module

Title: Finding the BEST answer to a problem.

An introduction to linear programming as a problem-solving tool for "real world" applications. Includes games, graphing inequalities, and an introduction to concepts of wind and solar power.

Author: Kimberly Shuman

Grade Level/Subject:

10^{th} - 12^{th} grade / Physics, Advanced Algebra, any course involving Problem Solving

Curriculum Standards:

Mathematics Standards	Student Objectives that address the standard.
Number and Operations Standard	1. TLW use mathematical operations to create an optimization function for a linear program (LP). 2. TLW judge the reasonableness of the results of a LP.
Algebra Standard	1. TLW use the graphical method to solve a LP with two variables. 2. TLW use symbolic algebra to formulate a LP. 3. TLW formulate a LP to represent and understand quantitative relationships.
Geometry Standard	1. TLW use vertex-edge graphs to model and solve a LP.
Measurement Standard	1. TLW determine upper and lower limits to a LP using the graphical method.
Problem Solving Standard	1. TLW state in their own words how a LP is a problem solving tool for a real world example.
Reasoning and Proof Standard	1. TLW use the online LP solver to prove the LP solution found using the graphical method.
Communication Standard	1. TLW explain the mathematical logic involved with formulating a LP. 2. TLW communicate orally and written, how a solution was found to a LP problem.
Connections Standard	1. TLW identify how the methods and mathematics used in linear programming can relate to a non mathematical application. 2. TLW explain the connection between the constraints of a LP and the optimal solution to the LP.
Representation Standard	1. TLW use the graphical representation of a LP to explain the formulation and solution of the

	LP.

Science Standards	Student Objectives that address the standard.
Science as Inquiry	1. TLW derive questions and concepts that guide the formulation of a LP. 2. TLW use technology and mathematics to solve a scientific problem. 3. TLW communicate and defend a scientific issue using the solution to a LP.
Science and Technology	1. TLW identify a scientific problem that could be solved using LP methods. 2. TLW evaluate the solution to a LP and explain how that could help the user of the LP make informed decisions.
Science in Personal and Social Perspectives	1. TLW discuss the objective of the NREL Wind Model, and how that helps the Government make decisions about wind power usage. 2. TLW understand the advantage to using Wind Power over existing energy technologies.

Overview:

In this unit, students will learn about Linear Programming (LP) as a problem solving tool. They will participate in group activities to find the best possible answers to a couple "real world" problems, two of which are related to wind and solar energy usage. Then, they will be introduced to how those same problems could be solved using a linear program (LP). Finally, students are asked to formulate a LP for a renewable energy application, solve it using a graphical method, and then explore online solving tools to verify the answer they got from the graphical method.

Purpose:

The purpose of this unit is to introduce students to problem solving tools used in the "real world." The government uses linear programs to help them make decisions about how to utilize wind power. Within this unit students will be asked to develop small linear programs that will help them see how mathematics can be used to make very important business and energy related decisions. Additionally, this unit will introduce the concepts of wind and solar energies as viable alternative energy resources that students can use in their own home, and that their schools can use to save money.

Vocabulary:

The following terms will be new to many students. All the terms are defined within the activities where they are used.

Linear Program	Constraint
Decision variables	Feasible region
Optimization function	Optimal solution
Supply	Demand

Resources and Materials:

- Handouts (2 Distribution games, Green Power Club Activity)
- Teacher lesson plans (with background information)
- Ruler
- Calculator
- Computers with Internet access, or at least a teacher computer with ability to show the screen to the class

Distribution Game 1 requires the following for each set. Either one set can be used for a demo, or each team could be provided with a full set to help them solve the problem.

Each set requires:

- 8 toy cars
- 2 Supply signs (provided with handout)
- 2 Demand signs (provided with handout)
- 4 transportation tickets (provided with handout)
- $40,000 in play money (Monopoly money, or make your own currency)
    - 1 $20,000 note
    - 2 $5,000 notes
    - 10 $1,000 notes

Preparatory Activities & Prerequisite Knowledge:

There are no required preparatory activities. Teachers who utilize a science or math journal could have students write a journal entry in response to the following question:

"If you owned a Porsche factory, you must get all your cars to people who want to buy them. What do you have to think about to do this? List at least 3 questions you would have to get answers to before you could get your cars to the buyers."

Here is an example: How many cars do people want to buy? -This would be something you would need to know so you could determine how many cars to make.

Students should already know or be familiar with the following:

- how to plot/construct a graph (x and y axes)
- how to plot inequalities (using shading)
- how to write and interpret mathematical equations involving inequalities
- how to identify simple number patterns using a table

Classroom Activities (3 days in a normal schedule with 50 minute periods):

Day 1 – Play Distribution Game 1

Teacher Prep Information:

This should include a brief explanation and demonstration of the game. The idea of the game is that we are trying to ship cars from the factories to the showrooms and spend the least amount of money possible while still meeting the demand of the showrooms.

The class should work in groups of 3-4 people to solve this problem with hands-on tools (provided) and a worksheet to help guide them to find a solution.

The worksheet and some of the game materials are attached at the end of this module description.

Class Outline:

Duration	Activity
5 min	**Introduce Distribution Game**. If preparatory journal activity was used, discuss responses at this time. Do a brief demonstration of the distribution game, and how the cars, money and tickets should be used to help solve the problem.
3 min	**Assign groups** (pick groups in advance) and pass our game materials.
30 min	**Group Work** – Teams should solve the problem to find the best possible solution they can. - Teacher should circulate to provide assistance. - Teacher should also inform groups that their final answer and brief explanation of how they got it will be shared with the class at the end of the 30 min.
10 min	**Discuss results.** – Teacher should make a table on the board to capture each team's solution as it is shared. Hopefully most teams will get the same answer ($32,000). • Any variations should be discussed, to find out the difference in problem solving logic between teams that got a common answer and teams that got a different answer. Have a representative from 2 teams that got difference answers to briefly explain how they decided to make their shipments. • Teacher should introduce the idea of an "optimal solution." The common answer that many teams will find for the minimum total cost is actually the "optimal solution to the problem, it is the best possible answer to the problem, not the only answer, but the BEST answer, which makes it the "optimal solution."

2 min — **Collect Game Materials and Pass out Homework**

- Homework is another distribution game, similar to the first game. This one is related to shipping wind energy. They should complete the activity by the next class. Students might want to keep the first distribution game to help them with their homework.

Day 2 – Wind Distribution Game Discussion & Green Power Club Activity

Teacher Prep Information:

This class period should begin with a discussion of the night's homework. Collect a sampling of solutions from the class to see if a common answer was found. Ideally everyone will have found the "optimal solution." This should be followed by a brief discussion of the overall uses of LP's and more specifically the use of the Wind Model by the Department of Energy. This discussion is designed to get the students interested, and help them see the relevance of the activities in this unit.

This discussion shouldn't take long, but it is important for the students to hear that LP's are actually used by the government, and large companies, when they have to make decisions that could cost them very large sums of money. The idea is that by using an LP people can make informed decisions, and not just make guesses as to what the best possible answer is. By formulating the problem as an LP, they can use computers to solve it, and the optimal solution will be provided once the problem is solved.

The government has built an LP to help them decide how to use and market wind energy over the next 50 years. The program has included all the information about how much energy is needed over all those years, how much it costs to build wind towers, how much it costs to use other energy sources, and how many transmission lines are built and how much it would cost to build new ones.

The optimal solution will tell the government how many new wind towers to build, where to build them, when to build them, and how much it will cost. Imagine trying to figure all this out without a tool to help? Imagine trying to understand all the costs involved over the next 50 years! Thank goodness we have computers to do that problem solving for us.

Class Outline:

<u>**Duration**</u>	<u>**Activity**</u>
5 min	**Discuss Wind Distribution Game**. Teacher should gather answers from some of the class members, and place these solutions on the board. Any differences should be discussed. Ideally all students will have found the same answer, which is the "optimal solution."
5 min	**Wind Model/LP uses Discussion**. This should be a brief teacher led discussion about the importance of LP's, who uses them and why they are helpful. The Wind Model should be mentioned to tie into the theme of the homework and the upcoming activities.

	Information is provided in the Teacher Prep Information section to help during this discussion.
2 min	**Introduce Green Power Club Activity**. Give a brief introduction to the activity, and pass out the packet of materials to each student.
5 min	**Read the Introduction page together**.
35 min	**Small group work**. Groups should complete Steps 1-3 in the packet by the end of the period.

Day 3 – Complete Green Power Club Activity

Teacher Prep Information:

This is the final day of the unit. Students should be ready to begin with page 4 of the Green Power Club Activity packet. Page 4 will be completed in class, the teacher should facilitate this process.

Once the graph is completed and an optimal solution is found, students should use an online LP solver to verify their answer. As the instructor, you should try out the online tool first to become familiar with how to use it. There are instructions on the website. If there are enough computers for each student, then they should work independently. Students should enter the LP as specified and solve it. They should get the same answer (P=$350) when they graph it, and when they use the online solver.

The online LP solver can be found at the following address:

http://people.hofstra.edu/faculty/Stefan_Waner/RealWorld/simplex.html

Class Outline:

Duration	Activity
15 min	**Go over Steps 1-3**. Go through the work done yesterday, encourage students to explain their thought processes, not just tell the class their answers.
20 min	**Complete Graphical Method activity** on page 4. Do this together as a class, each student must complete their own graph and LP formulation.
15 min	**Use the online solver to verify optimal solution**. If computers are available for all students, each should complete this on their own, otherwise work with what computer resources are available. If only a teacher computer is available, show on the board what is being entered into the solver. Solve the problem, and have a student come up to the computer to verify that the answer (P=$350) has been found.

Unit Grading Rubric:

The following rubric should be used to assess the work of each student. Although there is group work involved, each student should be graded individually. There is a component within the rubric to assess students on their contribution to the group work and class discussions.

Criteria	Not Proficient "1"	Proficient "3"	Advanced "5"	Grade Received Assign a 1-5
Distribution Game 1	-Does not complete Game 1 worksheet - Does not turn in own game worksheet	- Completes own Game 1 worksheet	- Completes own Game 1 worksheet - Contributes to discussion of problem solving method used	
Distribution Game 2 – Wind Game Homework	- Completes less then 50 % of homework - Does not turn in homework on time	- Completes own Game 2 worksheet - Turns in home-work on time	- Completes own Game 2 worksheet - Contributes to discussion of problem solving method used	
Green Power Activity	- Completes fewer then 2 Steps of the GP Activity - Does not complete graphing activity. - Does not turn in own GP Activity worksheet	- Completes own GP Activity worksheet, Steps 1-3 at least 75% complete. - Completes graph, with all labels, lines and areas shaded.	- Completes all 3 Steps of the GP Activity worksheet. - Graph is neat and shaded area highlighted and vertices labeled. - Contributes to discussion on Steps 1-3.	
Group Work Participation	- Does not participate in group activity. - Does not contribute ideas to problem solving.	- Participates in group activities. - Makes contributions to group decisions - Shows interest in group's success.	- Participates in group activities. - Makes contributions to group decisions - Takes on leadership role within the group	
Class Participation	- Does not pay attention during class discussions - Does not play the distribution game with their group	- Participates in class discussions - Shares thoughts and answers questions	- Participates in class discussions - Shares thoughts and answers questions - Offers to share problem solving methodology	
Total Points Received	**A:** 25-22 **B** 21-19 **C** 18-15 **D** 14-12			

Name ______________________________
Date ________

Distribution Game

Game 1

Porsche has factories in Detroit MI and Richmond, VA, and then ships their cars to their showrooms and dealerships in Los Angeles, CA and New York, NY. Shipping costs for each car are summarized in the table below:

Source	**Destination**	**Shipping Cost**
Detroit, MI	Los Angeles, CA	$30
	New York, NY	$40
Richmond, VA	Los Angeles, CA	$60
	New York, NY	$50

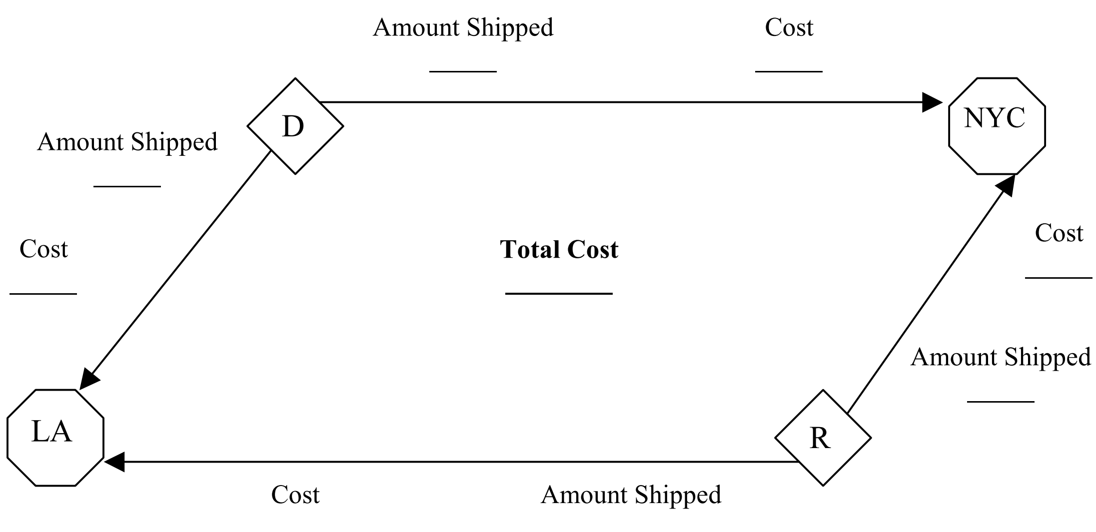
The supply of cars and the demand of cars are summarized in the table below:

Supply	**Demand**
Detroit, MI = 200	Los Angeles, CA = 300
Richmond, VA = 600	New York, NY = 400

How should shipments be made from Detroit and Richmond to minimize the shipping costs?

PLAY THE GAME!!

Explain the solution you found using the diagram below. For each route, indicate how many cars were shipped along that route, and the cost for each of the shipments. Then, calculate the total shipping cost, by adding all the individual shipping costs.



Name ________________________________
Date _________

Distribution Game

Game 1 : TEACHER KEY

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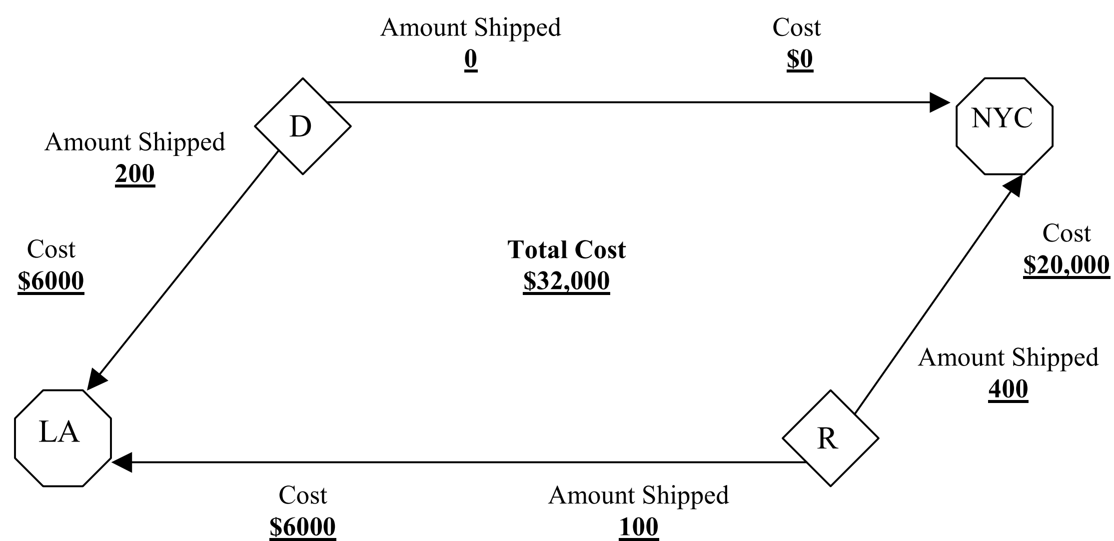


Name ________________________________
Date ________

Distribution Game

Wind Game

Xcel Power has a Wind Farm in northern Colorado, near the Wyoming border, this is called the Ponnequin Facility, they also have a Wind Farm near Peetz, CO near the Nebraska border. Xcel is able to offer Wind power as an alternative energy resource to consumers in CO, and NM with these two Wind Farms. As the wind blows, the turbines transfer the wind energy into electricity that we can use to light our house, run our refrigerator and keep our alarm clock running. This energy is shipped along ***transmission lines*** that get it from the Wind Farm to the neighborhoods that use the power. Wind Power is shipped to Denver and to Grand Junction. There is a cost to ship the energy and this cost is what we pay the energy company. We pay in kilowatt hours, meaning how much energy we use in an hour. Transmission costs for each hour of energy are summarized in the table below:

Source	**Destination**	**Shipping Cost (¢/kWh)**
Ponnequin Facility **(PF)**	Denver	6¢
	Grand Junction	8¢
Wind Farm in Peetz, CO **(WF)**	Denver	7¢
	Grand Junction	9¢

The supply of cars and the demand of cars are summarized in the table below:

Supply	**Demand**
Ponnequin Facility **(PF)** = 30,000 kWh	Denver = 40,000 kWh
Wind Farm in Peetz, CO **(WF)** = 25,000 kWh	Grand Junction = 10,000 kWh

How should Xcel transmit the needed energy to minimize the transmission costs?

PLAY THE GAME!!

1. Explain the solution you found by drawing a diagram. Label the Wind farms, and the demand areas. You must draw the transmission lines going from the Wind Farms to the demand areas.

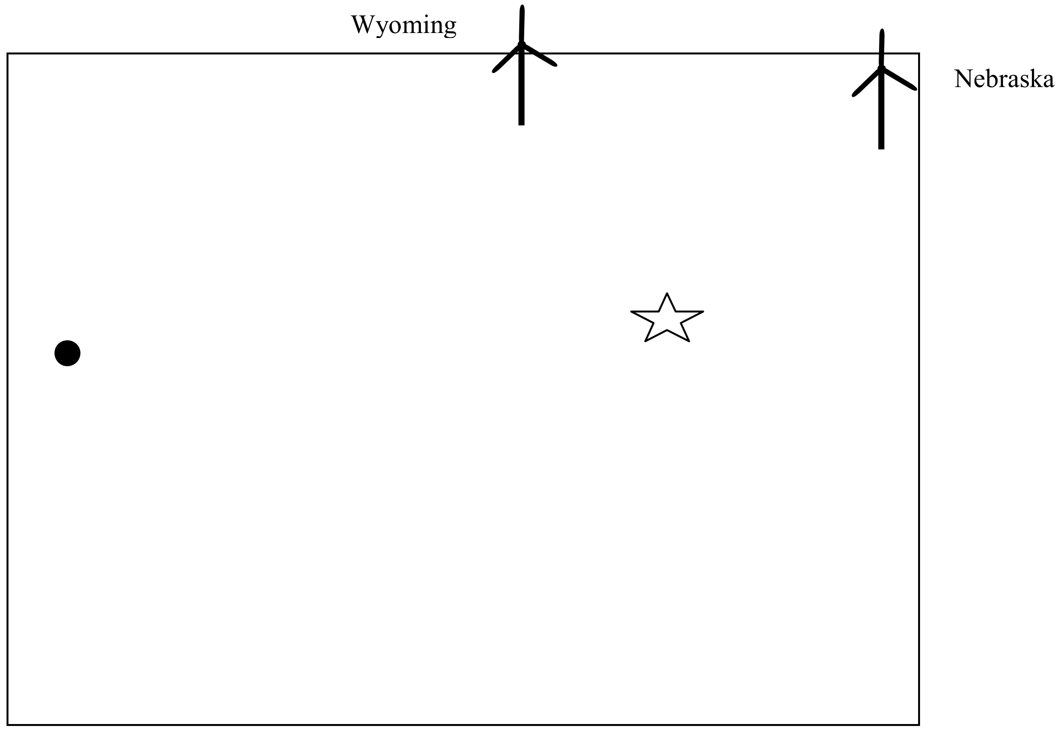
2. For each transmission line, indicate how many kWh of energy were shipped along that transmission line, and calculate the cost for the energy shipments.

3. Finally, calculate the total transmission cost to Xcel, by adding all the individual shipping costs.

Name ________________________________
Date ________

1. Label the diagram, and draw the transmission lines.

Colorado State Map



2. Complete the table below.

Transmission Line	Total Amount Shipped (kWh)	Cost to Ship ($)
PF to Denver		
PF to Grand Junction		
WF to Denver		
WF to Grand Junction		

3. Calculate the total shipping cost. **Total Shipping Cost =** ______________________

Distribution Game

Wind Game: TEACHER KEY

Xcel Power has a Wind Farm in northern Colorado, near the Wyoming border, this is called the Ponnequin Facility, they also have a Wind Farm near Peetz, CO near the Nebraska border. Xcel is able to offer Wind power as an alternative energy resource to consumers in CO, and NM with these two Wind Farms. As the wind blows, the turbines transfer the wind energy into electricity that we can use to light our house, run our refrigerator and keep our alarm clock running. This energy is shipped along ***transmission lines*** that get it from the Wind Farm to the neighborhoods that use the power. Wind Power is shipped to Denver and to Grand Junction. There is a cost to ship the energy and this cost is what we pay the energy company. We pay in kilowatt hours, meaning how much energy we use in an hour. Transmission costs for each hour of energy are summarized in the table below:

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Wind Farm in Peetz, CO **(WF)** = 25,000 kWh	Grand Junction = 10,000 kWh

How should Xcel transmit the needed energy to minimize the transmission costs?

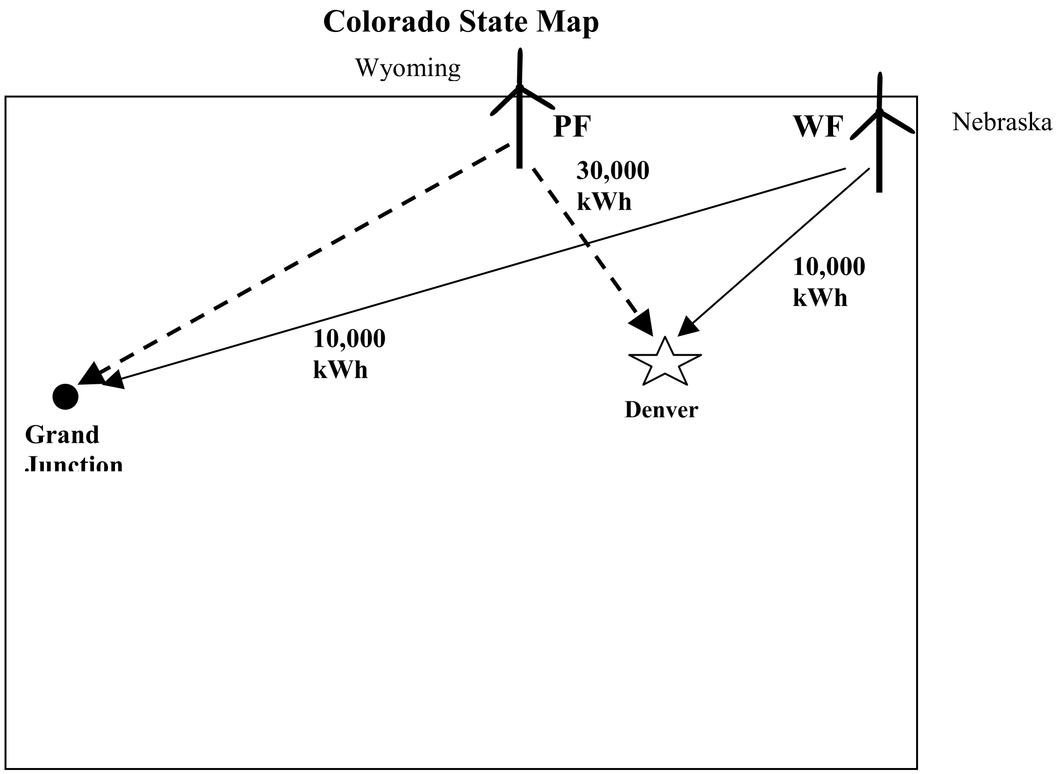
PLAY THE GAME!!

4. Explain the solution you found by drawing a diagram. Label the Wind farms, and the demand areas. You must draw the transmission lines going from the Wind Farms to the demand areas.

5. For each transmission line, indicate how many kWh of energy were shipped along that transmission line, and calculate the cost for the energy shipments.

6. Finally, calculate the total transmission cost to Xcel, by adding all the individual shipping costs.

2. Label the diagram, and draw the transmission lines.

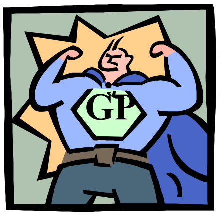


2. Complete the table below.

Transmission Line	Total Amount Shipped (kWh)	Cost to Ship ($)
PF to Denver	**30,000**	**$1,800**
PF to Grand Junction	**0**	**0**
WF to Denver	**10,000**	**$700**
WF to Grand Junction	**10,000**	**$900**

3. Calculate the total shipping cost. **Total Shipping Cost = ________<u>$3,4000</u>________**

Name ________________________________
Date ________



Green Power Club

Mission: Your mission, should you choose to accept it, is to equip your High School with the technology to harvest energy from the sun and the wind.

Background: It is possible for your school to produce all it's energy needs with the right amount of solar panels and wind turbines. The technologies can be placed on the roof of the school to get the best wind, and the best, unblocked sun rays.

The local energy company, Xcel, is willing to provide all the necessary equipment free of charge to the school, however there are two rules.

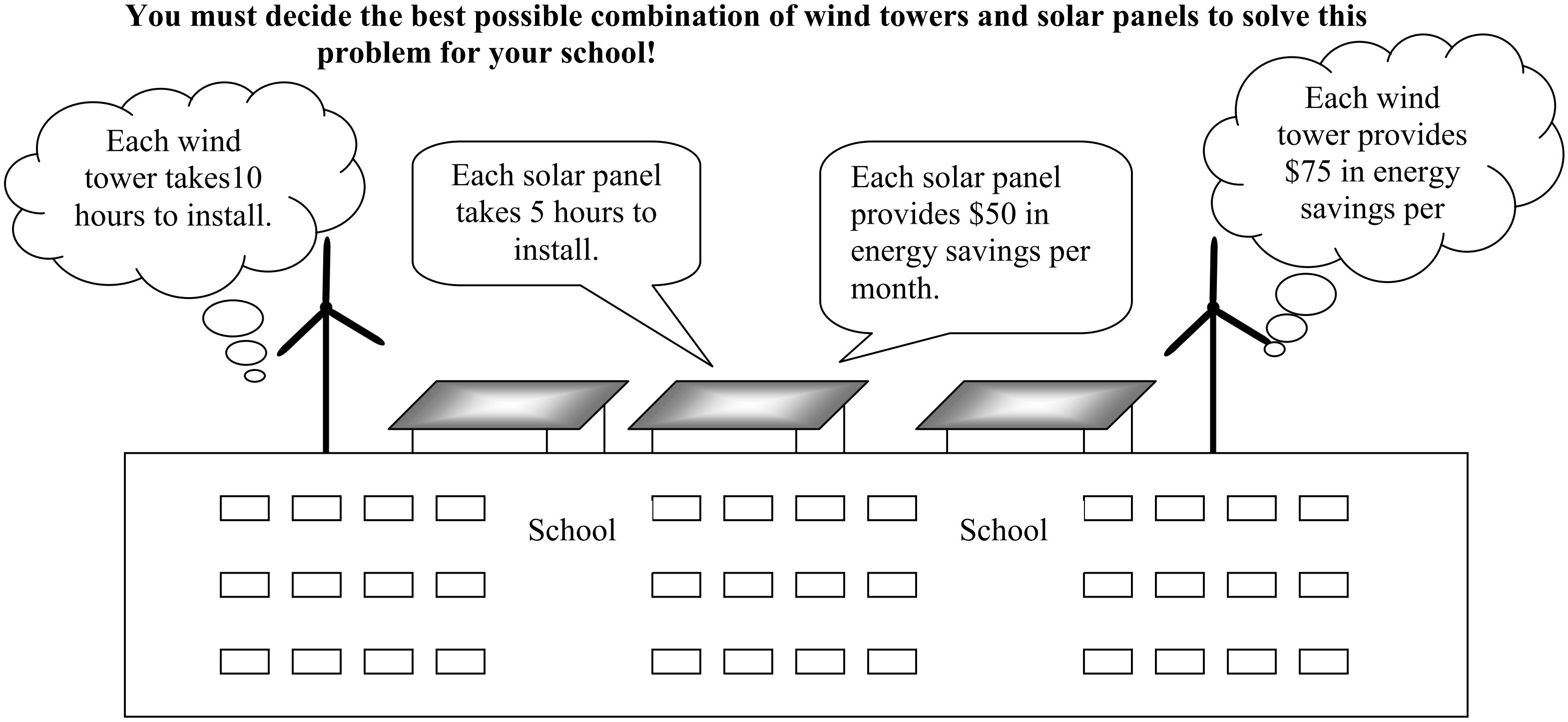
Rule 1: The Green Power Club must install all the wind towers and solar panels on their own, they can work no more then 2 hours a day on school days, and must complete all the installations within 1 month.
(Quick math: Total number of days =_______ so, Total build time =_______)

Rule 2: The Green Power Club must determine the correct number of wind towers and solar panels to install that will provide the school with **the most** energy savings, or profit possible, and they must prove their answers mathematically.

Key Facts: Each technology (solar and wind) will make a set amount of money each month, each type will take a certain amount of time to install, and will take up a certain amount of space on the roof.

The roof can hold a maximum of 6 Wind Towers and a max of 4 Solar Panels.

You must decide the best possible combination of wind towers and solar panels to solve this problem for your school!



Green Power Club

= Read Out loud

= Complete Activity

Formulate the Problem…(Common Steps to Solve an LP)

Step 1: Define your Decision Variables

What are the decisions must we make to solve this problem? These are our ***decision variables***. We have two decision variables in this problem, so we will call them X and Y.

Please define the decision variables for our problem in words in the space provided.

X = ____

Y = ____

Step 2: Identify your Optimization Function

When writing the ***optimization function*** you must think about the primary goal of your problem, and write a mathematical equation that uses the decision variables within the equation.

The Optimization Function is something you either want to maximize or minimize. Often it is related to profit, time or quantities of something.

Fill in the blanks below with the terms ***minimize*** and ***maximize***.

The goal of the Green Power club is to install solar and wind systems to ________________ the profit gained, and _________________ the overall energy costs to the school.

Now we must write that as a mathematical equation. Think about how profit will be calculated. Fill in the blanks with the correct numbers.

Profit (P) = _________ X + _________Y

Final Optimization Function:

______________ P where P = _______ X + ______ Y

Step 3: Determine your Constraints

Look back at the first worksheet that explains the situation. Read it again, the problem has some rules and key facts that limit what the solution can be.

The limiting factors, or values that greatly affect the final answer to a problem are called the ***constraints***. Constraints are written as mathematical equations, and are very important for solving a linear program.

Constraint 1: Roof Space Available to Wind Towers

Choose the correct constraint equation from the possible constraints below. On the lines provided, explain why you chose the constraint you did. ***(Remember what X and Y are!)***

a. $Y \leq 4$ **b. $X \leq 6$** **c. $X < 6$** **d. $Y < 6$**

Explain this constraint in words:

____

____

Constraint 2: Roof Space Available to Solar Panels

a. $Y \leq 4$ **b. $X \leq 4$** **c. $X < 6$** **d. $Y < 4$**

Explain this constraint in words:

____

____

Constraint 3: Time Available to Build

Complete the tables below using the information provided on the first page.

How long does it take to build Wind Towers?

# of Towers	Total Build Time
1	
2	
3	
X	

How long does it take to build Solar Panels?

# of Panels	Total Build Time
1	
2	
3	
Y	

When you add all the build times together it must be less then what value? ____________

Total Build Time for Wind + **Total Build Time for Solar** $\leq$ **Total Time Available to Build**

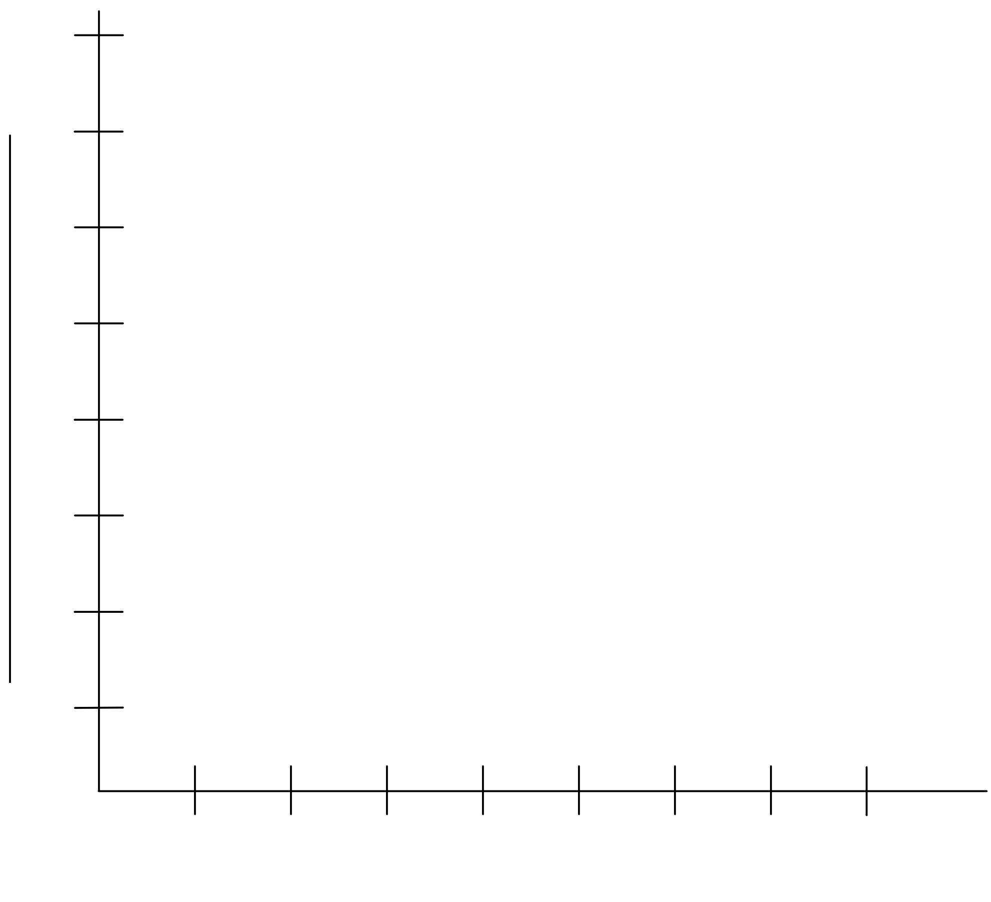
______ **X** + ______ **Y** $\leq$ ______

Writing the Final LP
&
Solving Using the Graphical Method

<u>**Standard LP Format**</u>	<u>**Green Power Club LP**</u>
Maximize P = *(Optimization Function goes here)* **Such that** *(Constraint 1 goes here)* *(Constraint 2 goes here)* *(Constraint 3 goes here)*	**Maximize P =** **Such that**

Solve using Graphical Method

1. Label the X and Y axes.
2. Graph Constraints 1, 2 and 3. Each will make a line. Remember that graphing inequalities requires shading the area on one side of the line.
3. Outline in pen, or highlighter the ***"feasible region"*** – or the area where the shading from all 3 lines, or constraints, overlap. This will be a trapezoid shaped area.
4. Locate the vertices of the trapezoid placing a dark circle on each vertex, and place the coordinates of the vertex next to it.
5. Finally, follow the teacher to solve for the ***optimal solution***.



Green Power Club

= Read Out loud

= Complete Activity

TEACHER KEY

Formulate the Problem…(Common Steps to Solve an LP)

Step 1: Define your Decision Variables

What are the decisions must we make to solve this problem? These are our ***decision variables***. We have two decision variables in this problem, so we will call them X and Y.

Please define the decision variables for our problem in words in the space provided.

X = __**Number of wind towers to build**__

Y = __**Number of solar panels to build**__

Step 2: Identify your Optimization Function

When writing the ***optimization function*** you must think about the primary goal of your problem, and write a mathematical equation that uses the decision variables within the equation.

The Optimization Function is something you either want to maximize or minimize. Often it is related to profit, time or quantities of something.

Fill in the blanks below with the terms ***minimize*** and ***maximize***.

The goal of the Green Power club is to install solar and wind systems to __maximize__ the profit gained, and __minimize__ the overall energy costs to the school.

Now we must write that as a mathematical equation. Think about how profit will be calculated. Fill in the blanks with the correct numbers.

Profit (P) = __75__ X + __50__ Y

Final Optimization Function:

__Maximize__ P where P = __75__ X + __50__ Y

Step 3: Determine your Constraints

Look back at the first worksheet that explains the situation. Read it again, the problem has some rules and key facts that limit what the solution can be.

The limiting factors, or values that greatly affect the final answer to a problem are called the ***constraints***. Constraints are written as mathematical equations, and are very important for solving a linear program.

Constraint 1: Roof Space Available to Wind Towers

Choose the correct constraint equation from the possible constraints below. On the lines provided, explain why you chose the constraint you did. ***(Remember what X and Y are!)***

a. $Y \leq 4$ **b. $X \leq 6$** **c. $X < 6$** **d. $Y < 6$**

Explain this constraint in words:
The roof can only hold up to 6 wind towers, so the amount of wind towers installed (X) can not exceed 6.

Constraint 2: Roof Space Available to Solar Panels

a. $Y \leq 4$ **b. $X \leq 4$** **c. $X < 6$** **d. $Y < 4$**

Explain this constraint in words:
The roof can only hold up to 4 solar panels, so the amount of solar panels installed (Y) can not exceed 4.

Constraint 3: Time Available to Build

Complete the tables below using the information provided on the first page.

How long does it take to build Wind Towers?

# of Towers	Total Build Time
1	**10**
2	**20**
3	**30**
X	**10X**

How long does it take to build Solar Panels?

# of Panels	Total Build Time
1	**5**
2	**10**
3	**15**
Y	**5Y**

When you add all the build times together it must be less then what value? __**40 hours**__

Total Build Time for Wind + Total Build Time for Solar ≤ Total Time Available to Build

__**10**__ **X** + __**5**__ **Y** ≤ __**40**__

Writing the Final LP

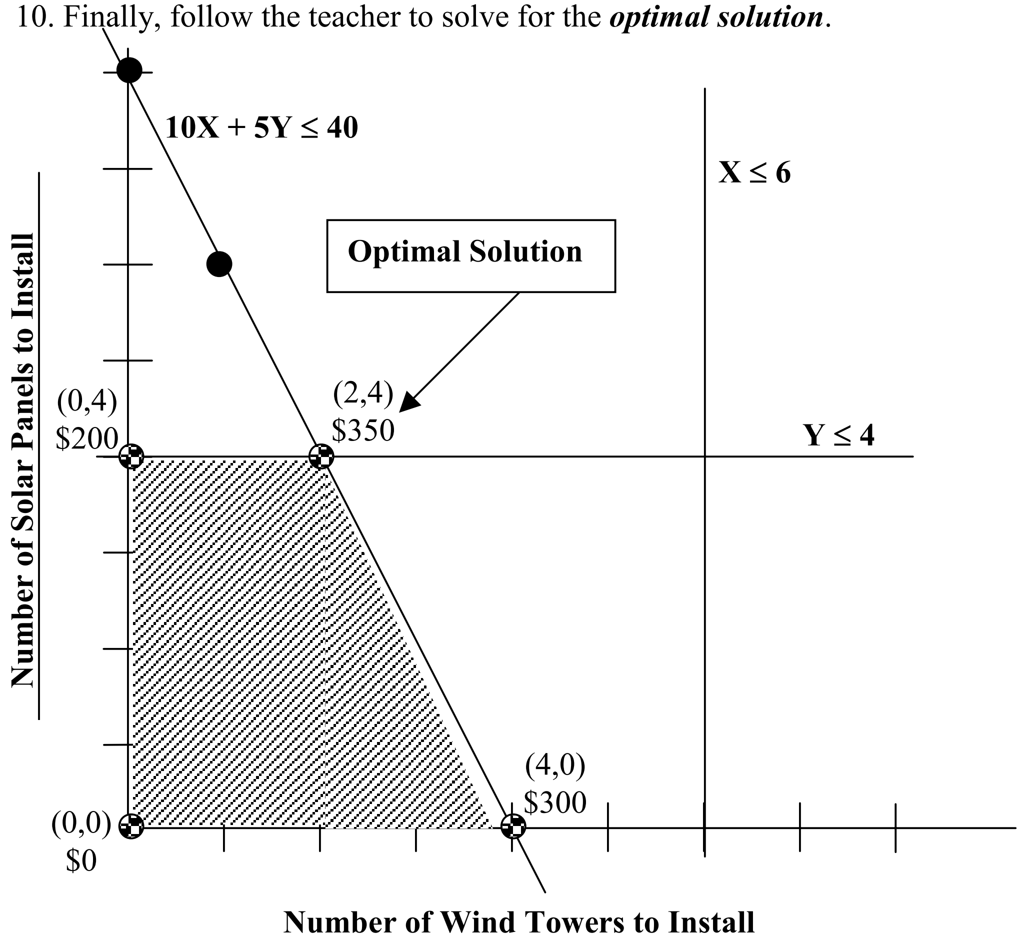
&

Solving Using the Graphical Method

<u>**Standard LP Format**</u>	<u>**Green Power Club LP**</u>
Maximize P = *(Optimization Function goes here)*	**Maximize P = 75X + 50Y**
Such that	**Such that**
(Constraint 1 goes here)	**X ≤ 6**
(Constraint 2 goes here)	**Y ≤ 4**
(Constraint 3 goes here)	**10X + 5Y ≤ 40**

Solve using Graphical Method

6. Label the X and Y axes.
7. Graph Constraints 1, 2 and 3. Each will make a line. Remember that graphing inequalities requires shading the area on one side of the line.
8. Outline in pen, or highlighter the ***"feasible region"*** – or the area where the shading from all 3 lines, or constraints, overlap. This will be a trapezoid shaped area.
9. Locate the vertices of the trapezoid placing a dark circle on each vertex, and place the coordinates of the vertex next to it.
10. Finally, follow the teacher to solve for the ***optimal solution***.



Additional Materials
Distribution Game 1

SUPPLY

Detroit, MI

200 Cars

SUPPLY

Richmond, VA

600 Cars

DEMAND

Los Angeles, CA

300 Cars

DEMAND

New York, NY

400 Cars

Transportation Ticket

Shipping From: ____________

Shipping To: ____________

Amount of Cars Shipped: ____________

Cost: ________

Transportation Ticket

Shipping From: ____________

Shipping To: ____________

Amount of Cars Shipped: ____________

Cost: ________

Transportation Ticket

Shipping From: ____________

Shipping To: ____________

Amount of Cars Shipped: ____________

Cost: ________

Transportation Ticket

Shipping From: ____________

Shipping To: ____________

Amount of Cars Shipped: ____________

Cost: ________